Water Quality Parameters Typically Monitored by VRAP Groups

VRAP loans water quality monitoring kits that include equipment and supplies for measuring baseline parameters: water temperature, dissolved oxygen, pH, specific conductance, and turbidity. VRAP also trains volunteers to collect water samples for bacteria, nutrient, and metals analyses. Water quality parameters and an abbreviated summary of the applicable New Hampshire Surface Water Quality Regulations are given below. The New Hampshire Surface Water Quality Regulations are available through the DES Public Information Center at (603) 271-2975 or at www.des.state.nh.us/wmb/Env-Ws1700.pdf.

Temperature

Temperature is one of the most important and commonly observed water quality parameters. Temperature influences the rate of many physical, chemical and biological processes in the aquatic environment. Individual aquatic species have a range of temperatures and other factors that best support their reproduction and the survival of offspring. Temperature can also impact aquatic life because of its influence on parameters such as ammonia, as well as the concentration of dissolved oxygen in the water.

Temperature in Class B waters shall be in accordance with RSA 485-A:8, II which states in part "any stream temperature increase associated with the discharge of treated sewage, waste or cooling water, water diversions, or releases shall not be such as to appreciably interfere with the uses assigned to this class."

Dissolved Oxygen

Adequate oxygen dissolved in the water is crucial to the survival and successful reproduction of many aquatic species. Organisms such as fish use gills to transfer oxygen to their blood for vital processes that keep the fish active and healthy. Oxygen is dissolved into the water from the atmosphere, aided by wind and wave action where it tumbles over rocks and uneven terrain. Aquatic plants and algae produce oxygen in the water, but this contribution is offset by the respiration and decomposition of plants and other organic matter. Bacteria utilize oxygen as they process organic matter deposited in the river into smaller and smaller particles.

Dissolved oxygen (DO) in water is measured using a meter that produces readings for both concentration (expressed as milligrams per liter) and saturation (expressed as a percentage). **Concentration** is equal to the mass of oxygen per volume of water, whereas **saturation** is a measurement of the amount of oxygen in the water compared to the amount that the water is capable of holding. Both of these measurements are necessary to accurately determine whether New Hampshire surface water quality standards are met. For example, in Class B waters, any single DO reading must be greater than 5 mg/L. In addition, the daily average saturation value shall be at least 75 percent to meet state water quality standards.

Several measurements of oxygen saturation taken in a 24 hour period must be averaged to compare to the 75 percent daily average saturation standard. The concentration of dissolved oxygen is dependent on many factors including temperature and sunlight, and tends to fluctuate throughout the day. Saturation values are averaged because a reading taken in the morning may be low due to respiration, while a measurement that afternoon may show that the saturation has recovered to acceptable levels. Water can become saturated with more than 100 percent dissolved oxygen. It should be noted that other DO requirements in the New Hampshire Code of Administrative Rule ENV-WS 430 pertain to cold water fish spawning areas, impoundments (dams), and reservoirs.

pH

pH is a measure of hydrogen ion activity in water. The lower the pH, the more acidic the solution due to higher concentrations of hydrogen ions. A high pH is indicative of an alkaline or basic environment. pH is measured on a logarithmic scale of 0 to 14. Acid rain typically has a pH of 3.5 to 5.5. New Hampshire's rivers have historically shown a range of pH values from 4.5 to 9. Most aquatic species need a pH of between 5 and 9. pH also affects the toxicity of other aquatic compounds such as ammonia and certain metals.

New Hampshire Surface Water Quality Regulations state that pH shall be between 6.5 and 8, unless naturally occurring. Sometimes, readings that fall below this range are determined to be naturally occurring, perhaps because of the influence of wetlands near the sample station. This is due to the presence or release of tannic and humic acids by decaying plants, which can create more acidic waters in areas influenced by wetlands.

Specific Conductance

Specific conductance is the numerical expression of the ability of water to carry an electrical current, which is a measure of free ion content in the water. Water contains ions (charged particles), which come from natural sources such as bedrock, or are introduced by human activity. These materials carry an electrical current. Specific conductance can be used to indicate the presence of chlorides, nitrates, sulfates, phosphates, sodium, magnesium, calcium, iron, and aluminum ions.

The term “specific conductance” is used in the VRAP because the actual measurement is of the *conductivity* (or electric current) at a *specific* water temperature. In some studies and programs, the term “conductivity” is used. This term should only be used when the measurement does not adjust to a specific temperature.

In New Hampshire, there is no standard for specific conductance, because levels naturally vary a great deal according to the geology of an area. Specific conductance readings are useful in locating potential pollution sources because they usually have higher specific conductance than unimpaired surface waters.

Turbidity

Turbidity is a measurement of the amount of light that is scattered by a water sample. Turbidity can be used as an indicator of the amount of suspended material in the water, such as clay, silt, algae, and decaying plant material. A high degree of turbidity can interrupt the passage of light through the water and can add heat to the water by absorbing sunlight. Clean waters are generally associated with low turbidity, but there is a high degree of natural variability involved. Rain events often contribute turbidity to surface waters by flushing sediment, organic matter and other materials from the surrounding landscape into surface waters. New Hampshire surface water quality standards state that Class B waters shall not exceed naturally occurring conditions by more than 10 Nephelometric Turbidity Units (NTUs).

Bacteria

Organisms causing infections or disease (pathogens) are often excreted in the fecal material of humans and other warm-blooded animals. *Escherichia coli* (*E. coli*) bacteria is almost universally found in the intestinal tracts of humans and warm blooded animals and is a good indicator of fecal pollution and the possible presence of pathogenic organisms.

In fresh water, *E. coli* concentrations help determine if the water is safe for recreational uses such as swimming. New Hampshire surface water quality standards state that Class B waters shall contain not more than either a geometric mean based on at least three samples obtained over a 60 day period of 126 *E. coli* per 100 milliliters (CTS/100mL), or greater than 406 *E. coli* CTS/100mL in any one sample. A geometric mean is a type of average that better describes *E. coli* levels relative to the natural characteristics of *E. coli* in water.

Total Phosphorus

Phosphorus is a nutrient that is essential to plants and animals, however, in excess amounts it can cause rapid increases in the biological activity in water. This may disrupt the ecological integrity of streams and rivers.

Phosphate is the form of phosphorus that is readily available for use by aquatic plants. Phosphate is usually the limiting nutrient in freshwater streams, which means relatively small amounts of phosphate can have a large impact on the biological activity in the water. For example, excess phosphorus can trigger nuisance algal blooms and aquatic plant growth, which can decrease oxygen levels and the attractiveness of waters for recreational purposes.

High phosphorus levels can be an indicator of sewage, animal manure, fertilizer, erosion, and other types of contamination. New Hampshire does not currently have a numeric surface water quality standard for phosphorus due to the high degree of natural variability. However, phosphorous is usually not a concern in free flowing rivers and streams until levels exceed 0.05 mg/L.

Metals

Depending on the metal concentration, its form (dissolved or particulate), and the hardness of the water, trace metals can be toxic to aquatic life. Metals in dissolved form are generally more toxic than metals in the particulate form. The dissolved metal concentration is dependent on the pH of the water, as well as the presence of solids and organic matter that can bind with the metal to render it less toxic. Hardness is primarily a measure of the calcium and magnesium ion concentrations in water, expressed as calcium carbonate. The hardness concentration affects the toxicity of certain metals. New Hampshire water quality regulations include numeric criteria for a variety of metals.

Since dissolved metals are typically found in extremely low concentrations, the potential contamination of samples collected for trace metals analyses has become a primary concern of water quality managers. To prevent such contamination and to ensure reliable results, the use of "clean techniques" is becoming more and more frequent when sampling for dissolved metals. Because of this, sampling for metals may be more costly and require additional effort than in the past.